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TRANSVERSE-WAVE HIGH-POWER TUBE

QUARTERLY REPORT NO. 3

By

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ZENITH RADIO RESEARCH CORP.

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ABSTRACT

Research and development work is described on a traveling-wave power amplifier tube employing transverse-wave interaction between the negative synchronous wave and a circuit wave on a balanced structure. The theoretical advantage in this arrangement is the possibility of high-power amplification with high overall efficiency, due to the lack of longitudinal or transverse velocity modulation in the spent beam.

Final assembly of the first tube is described along with the difficulties encountered.

Processing is also described and the tube is shown mounted on the vacuum station.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Abstract	i
Table of Contents	ii
List of Illustrations	iii
1 Statement of Problem	1
2 Background	1
3 Tube Assembly	1
4 Tube Processing	2
5 Conclusions	2
6 Future Plans	2

LIST OF ILLUSTRATIONS

<u>Fig. No.</u>		<u>Page</u>
1	Prototype Transverse-Wave Tube Mounted On Vacuum Station	3
2	Close-up View of Vacuum Station Mounting	4

1. STATEMENT OF PROBLEM

The purpose of this program is to conduct research and development of a theoretical and experimental nature, on a transverse-wave high-power amplifier tube in accordance with U. S. Army Electronics Command, Electron Tubes Division Technical Guideline No. MW-52A dated 28 June 1966, entitled "Cyclotron and Synchronous Wave Devices Investigation."

The first task of this program is to complete and test an experimental model to confirm the feasibility of the device and to demonstrate its ability to meet the performance goals. These are 1 kw of rf power at a depressed collector efficiency of at least 60% and with at least 20 db of saturated gain. This work will be performed at S-band.

Performance of the first model will help determine subsequent design and the feasibility of extending the design to X-band at a 10 kw level of power.

2. BACKGROUND

Design corrections were instituted during the previous period. This included changing the electro-formed waveguide sections to brazed assemblies of stainless steel and changing the window frame design. These units were completed and final assembly was initiated.

X-band calculations indicated that the gun requirements are reasonable and that the X-band circuit can be of a practical size.

3. TUBE ASSEMBLY

All of the work performed during this quarter was devoted to the final assembly of the prototype tube. Major difficulty was encountered with the waveguide windows and a further design modification was necessary before it was possible to complete the collector and gun assemblies and cycle them through the bake-out temperature range. The design change consisted primarily of making the Kovar window frame an integral part of the waveguide and moving the window location away from the heliarc joint.

No difficulty was encountered in the stacking of the 1100-piece circuit section. Also the attenuator sections were easily situated. Further, the circuit stack was successfully sintered and placed in its stainless steel housing.

In general, heliarcing of the various sections of the tube proceeded as expected except in the region of the window. This difficulty was alleviated in the design modification mentioned previously.

4. TUBE PROCESSING

It required a little over one week to process the tube. It was discovered at tip-off that a leak had developed in a kovar-to-stainless steel seal; also the input window developed a leak. These were patched by using glyptal and the tube was reprocessed.

The tip-off was unsuccessful because the tool malfunctioned. It was necessary to put a new tubulation on the tube and go through the process cycle again. Figures 1 and 2 show the tube on the vacuum station prior to tip-off. A new tip-off tool was obtained and this time the procedure was successful. The tube is now under test.

5. CONCLUSIONS

The tube assembly was more difficult than had been anticipated. With the design changes that have been incorporated, and the experience that has been gained, the assembly of subsequent models should be much easier.

Processing was less time consuming than had been expected with the exception of the problems caused by the leak in the seal and the window and malfunctioning tip-off tool.

6. FUTURE PLANS

The subsequent quarter will be devoted to the testing and evaluation of the prototype tube.



Fig. 1--Prototype transverse-wave tube mounted
on vacuum station



Fig. 2--Close-up view of vacuum station mounting.

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